APPLICATION FOR
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FOR

ROTARY POWERED SNACK PIECE TURNOVER

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BACKGROUND OF THE INVENTION

1. Technical Field

The present invention relates to a snack piece turnover device and method of using the same. More particularly, the invention relates to a snack piece turnover device employing a curved conveyor, which uses centrifugal force to turn snack pieces over, and the method of using the same.

2. Description of Related Art

Snack pieces are known to be prepared with the use of fryers. Generally, snack pieces such as potato and corn crisps are formed from dough and are sheeted and cut into discrete pieces (preforms) for treatment. Treatment involves cooking the preforms in a fryer to produce cooked snack pieces. Particularly with potato and corn crisps, a form fryer is beneficial because performs, which are sheeted and cut pieces of uncooked dough, can be molded and cooked into a desired product shape.

The dough comprises a substantially dry mixture of potato flakes and sugar. Other substances that may be utilized include starches for their ability to improve the texture, consistency, and durability of food products and to improve the processing of dough into food products. One or more emulsifiers may also be used for their ability to improve the processing of dough. After forming uncooked snack pieces, they can be processed into finished molded snack pieces.

A desirable feature of molded snack pieces is that they can be made uniform in size and shape. With uniformity, the snack pieces can be packaged in a seated alignment. This allows

snack product to be packed in a canister rather than in a loose bag. Canister packaging provides a degree of protection against breakage of the snack pieces while providing improved transportability of the snack pieces both in bulk and in individual canisters. Also, canisters can be sealed with a lid after opening to deter product degradation.

For packaging of uniformly shaped product such as curved ellipses, (for example, an ellipse having its longer sides curved upward in the same direction) snack pieces are stacked first before filling in a canister. Snack pieces can be stacked one directly over another, or they can be partially overlapped in a similar manner as rooftop shingles are overlapped. After such overlapping, the product pieces are then pushed together so that each piece is directly over the other. While it is possible to stack curved product pieces either with concave sides up or concave sides down, the product pieces may be more amenable to stacking in one particular orientation, depending on the product shape.

For example, thin, elliptical product pieces having upwardly-curved sides are more easily stacked with their concave sides down rather than up. In the event that two adjacent product pieces fail to overlap, those pieces can only be forced to stack one over the other if their adjacent edges are at different heights. With their concave sides up, two adjacent elliptical product pieces cannot be stacked because their adjacent product edges would lie flat against the conveyor, and those edges would confront each other upon pushing the pieces together. With their concave sides down, however, the product pieces are able to rock back and forth on their downwardly curving edges in the direction of travel. This ability to rock makes it highly unlikely that the adjacent edges of two pieces would confront each other at the same vertical level. One product piece will thus be able to overlap and eventually stack over the other.

Because many form fryers produce concave-side-up snack pieces, such concave-side-up pieces must be flipped prior to packaging. **Figure 1** shows an example of a prior art snack piece-flipping device. The prior art flipping system **10** flips curved, elliptical snack pieces **12** from concave-side up to concave-side down using a vacuum suction roller **22**. As shown, the snack pieces **12** have their longitudinal sides bent in the same direction, approximating a U-shape. The concave-side-up snack pieces **12** are conveyed on a wire-mesh type or other gas-permeable type of upper belt **20** towards the packaging stages. As the snack pieces **12** reach a vacuum suction roller **22** at the end of the upper belt **20**, the snack pieces **12** are retained by vacuum to the surface of the upper belt **20** and moved around the end roller **22** until each snack piece **12** is inverted and above a lower belt **30**, either right above or slightly downstream from the first roller **32** of the lower belt **30**. Once inverted, the concave-side-down snack pieces **12** are released from the upper belt **20** and dropped onto the lower belt **30**. The snack pieces **12** can then be stacked for packaging.

As is apparent, snack piece flipping technology allows snack pieces to be reoriented into positions more suitable for stacking. However, with prior art devices such as the vacuum roller **22** shown in **Figure 1**, snack piece retention to the roller is critical to the flipping process. Vacuum rolls are problematic as snack piece retention is not particularly consistent or reliable. For instance, the vacuum roller **22** and the upper belt **20** shown in **Figure 1** are prone to clogging from debris. Clogging prevents the vacuum roller **22** from properly retaining control over the snack pieces **12**, which may then drop prematurely from the vacuum roller **22**. Another problem is that the snack pieces **12** can stick to the upper belt **20** for too long or too short a period of time. If the snack pieces are not released precisely at the same point over the lower belt **30**,

misalignment and/or breakage of snack pieces can occur. Furthermore, vacuum rolls require a significant amount of energy to create the necessary suction force. Therefore an improved, more efficient and reliable flipping device and method are desired to avoid these problems.

SUMMARY OF THE INVENTION

A product-flipping device in accordance with the invention flips products such as snack pieces. Snack pieces such as potato crisps or other farinaceous-based snack products are often prepared in form fryers producing molded snack pieces. These snack pieces have shapes with at least two sides. Depending on the particular shape of the snack pieces, it is often desirable to turn the snack pieces over and into an orientation more amenable to packaging and/or seasoning.

When using a form fryer to cook food products, a conveyor moves product from the fryer exit on towards packaging and/or seasoning. In one embodiment of the invention, the conveyor feeds the cooked product towards a flipping apparatus whereby the product pieces will be turned over. The flipping apparatus comprises a terminal portion of a first conveyor that is nested within an upturned and curved portion of a second conveyor. The upturned portion of the second conveyor follows a curved path that defines a concavity in which the product pieces are flipped as they are transferred from one conveyor to the other. A channel is provided between the terminal portion of the first conveyor and the upturned terminal portion of the second conveyor for allowing passage therethrough of the product pieces being flipped. Centrifugal force enables the product pieces to gently transfer from one conveyor to the other and to be gently flipped as they pass through the channel.

The above as well as additional features and advantages of the present invention will become apparent in the following written detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives, and advantages thereof, will be best understood by reference to the following detailed description of illustrative embodiments when read in conjunction with the accompanying drawings, wherein:

Figure 1 is a schematic elevational view of a prior-art flipping device;

Figure 2 is a schematic elevational view of a flipping device in accordance with one embodiment of the present invention whereby flipping is achieved by leading product pieces through a curved path, and the curved path is formed by leading a conveyor around static guides;

Figure 3 is a schematic perspective view of the flipping device of **Figure 2**;

Figure 4 is a schematic perspective view of an alternative embodiment in which a curved path is formed by leading a conveyor around a grooved roller;

Figure 5 is a schematic elevational view of the flipping device of **Figure 4**; and

Figure 6 is a schematic elevational view of another alternative embodiment in which a curved path is formed by leading a conveyor around a grooved roller.

DETAILED DESCRIPTION

A product piece flipping apparatus **100** in accordance with the invention is shown in **Figures 2** and **3** for flipping food product pieces. Product pieces such as potato crisps or other farinaceous-based food products are often prepared in form fryers producing molded product pieces. As these product pieces are imparted with a particular shape, it is often desirable to turn the product pieces over for more efficient stacking, packaging and/or seasoning.

For example, a form fryer employing convex molds with convex sides facing the entering preforms will form product pieces **112** that are concave wherein the longitudinal edges of each cooked product piece are curved upward. While a generally elliptical shape is shown for the product pieces, other shapes are possible such as squares, circles, or triangles depending on the shape of the preforms. These shaped product pieces **112** are formed so that they may be stacked together in a seated arrangement for packaging in a canister-type container. However, shingled or spaced rows of such product pieces may be more amenable to stacking in one particular orientation. For instance, elliptically shaped potato crisps having their longer sides curved upwards, when arranged in rows, are more easily pushed together and stacked when resting concave-side-down on their curved, longer sides than when resting concave-side-up on their backs. Therefore the fully cooked product pieces **112** are turned over with a flipping apparatus **100** so that the product pieces **112** may be more easily stacked. Once stacked, a canister may be slid over this stack for packaging.

In one embodiment, fully cooked product pieces **112** are conveyed from a form fryer exit and are directed downstream to be seasoned, flipped and then packaged. The product pieces **112** are conveyed on the endless belt of a first conveyor **120** after cooking and/or seasoning to a

flipping apparatus **100**. The first conveyor **120** has a convex terminal end where the first conveyor's endless belt translates about an end roller **122**. As the product pieces **112** approach the end roller **122** at the terminal end of the first conveyor **120**, they pass under an upwardly curving portion **134** of a second conveyor **130** before being transferred to the second conveyor **130** and turned over in the curved portion **134**. Unlike the upper conveyor **20** of the prior art flipping apparatus shown in **Figure 1**, the conveyor material of the present invention is not limited to wire mesh or other gas-permeable materials. For example, the endless belts of the first and second conveyors **120**, **130** can comprise segments of metal or alloy, chain links, wire mesh, or they may comprise of a continuous sheet or belt of fabric, metal or polymer material. The conveyor material must be sufficient to withstand processing conditions such as the cooking temperatures and moisture levels that would be experienced in treating product pieces such as potato crisps.

At about the end roller **122**, which supports at least in part the first conveyor **120**, the second conveyor **130** follows a curved path **134** up and around the first conveyor **120**, thereby defining a concavity in which the convex terminal end of the first conveyor **120** is nested. The C-shaped curved path **134** comprises an upwardly curving portion of the second conveyor **130** and generally follows a path encircling but not touching the first conveyor's convex terminal end. Between the curved surface portion **134** of the second conveyor **130** and the first conveyor **120**, a curved channel **136** is provided through which the product pieces **112** can pass. The channel **136** is set large enough so that the product pieces **112** being conveyed will not be crushed or otherwise damaged when disposed between the first and second conveyors **120**, **130**. However, in the preferred embodiment, the channel **136** is sufficiently small in the area where the product

pieces **112** first lose contact with the first conveyor **120** so that there is little to no loss of contact with the product pieces **112** as they are transferred from the first conveyor **120** to the second conveyor **130**. Beginning from a downstream bottom roller **152**, which is positioned beneath the first conveyor **120**, the endless second conveyor **130** follows a return path defined by at least one return-path roller **162**. The second conveyor **130** travels beyond, up and around the first conveyor **120** as it is led about the return-path roller(s) **162**. Once the second conveyor **130** is elevated above the first conveyor **120**, the second conveyor **130** then travels over the first conveyor **120** to the curvature-segment top roller **132** where the second conveyor **130** begins its product piece collection path. Then the second conveyor **130** travels around the top roller **132** and follows two static guides **138** down the interior of the curved path **134**, forming the inner curved surface portion of the second conveyor **130**. As the product pieces **112** separate from and glide off of the end of the first conveyor **120**, they are collected from above by the second conveyor's inner curved (or curving) surface portion **134**, which is axial to the first conveyor's terminal end.

Centrifugal force allows the product pieces to transfer gently from the first conveyor **120** to the second conveyor **130** and to remain in contact with the second conveyor **130** throughout the second conveyor's curved path **134**. The inner curved surface portion **134** of the second conveyor **130** first makes contact with the upper portions of the product pieces **112** as (or shortly after) the lower portions of the product pieces **112** separate from the end of the first conveyor **130**, after which the curving surface portion **134** guides the product pieces downward and rotates them. The second conveyor **130** is operated at a velocity sufficient to create the centrifugal force necessary to ensure successful transfer of the product pieces **112** from the first conveyor **120** to

the second conveyor **130**. With sufficient centrifugal force, the product pieces **112** will remain in contact with the surface of the second conveyor **130** as they travel through the curved path **134**. However, if there is too much centrifugal force the product may be damaged. Thus, the amount of centrifugal force used must not be greater than the force required to break the product. Thus, the force must be sufficient to ensure contact with the surface of the second conveyor yet not exceed the breakage force. As used herein, breakage force is the force required to break the product pieces **112**. The apparatus may require adjustment as the inherent strength of the products vary. For example, product strength will depend upon whether the product is fried or baked, the geometry of the product, its ingredients, and its relative thickness. The apparatus's centrifugal force may be increased by either decreasing the radius of the end roller **122** and the curved surface portion **134** of the second conveyor. Likewise, the centrifugal force can be increased by increasing the velocity of the first and second conveyors **120, 130**. Conversely, the centrifugal force of the apparatus may be decreased by increasing the radius of the end roller **122** or by decreasing the velocity of the first and second conveyor **120, 130**. Thus, the velocity of the first and second conveyors **120, 130** and/or the diameter of the end roller **122** and associated channel **136** may require calibration when first brought on-line and subsequently if the product configuration changes. Further, the velocity of the first conveyor **120** is approximately matched to that of the second conveyor **130** so that the transferring product pieces **112** will not experience an abrupt change in velocity. Thereby, gentle transfer and rotation of the product pieces **112** is promoted without causing the product pieces **112** to deviate in position relative to one another. Once the product pieces **112** have traveled through the curvature segment **134**, the product pieces are conveyed along the remainder of the second conveyor **130** towards the packaging stages.

In the preferred embodiment, the curved path **134** of the second conveyor **130** has a semicircular cross-section. However, other curved shapes are possible. For example, the curved path **134** can alternatively comprise a curve with a gradually increasing radius wherein the lower portion of the curved path **134** has a larger radius than the upper portion of the curved path **134**. Such an increasing-radius curved path **134** helps minimize the increase in centrifugal force exerted upon the product pieces due to gravitational acceleration as they reach the lower portion of the curved path **134**. It also causes the channel **136** between the second conveyor's inner curved surface portion **134** and the terminal end of the first conveyor **120** to increase in the direction of motion, which in turn allows for more space between the first and second conveyors **120, 130**.

While the flipping apparatus **100** as depicted in **Figures 2** and **3** is shown with product pieces **112** being fed from a first conveyor **120** (the feeding conveyor in the depicted embodiment) and transferred down onto a second conveyor **130** (the receiving conveyor in the depicted embodiment) disposed below the first conveyor **120**, the method can be reversed. For example, product pieces **112** can be fed from the second conveyor **130** (the feeding conveyor in the reverse case) and transferred up onto the first conveyor **120** (the receiving conveyor in the reverse case) disposed above the second conveyor **130**. The reverse method need only provide sufficient velocity and hence centrifugal force to retain the product pieces **112** in position along the second conveyor **130** while traveling through a curved path **134**. If, while using the reverse method, it is desirable to have a more even distribution of centrifugal force throughout the curved path **134**, the curved path can have a decreasing radius in the direction of motion rather than a constant radius. However, the shape of the curved path **134** is not limited to semicircular and

decreasing-radius cross-sections and is constrained only by the requirement that the curved path **134** provide enough centrifugal force to retain control over the product pieces **112** without damaging them.

The general shape of the curved path **134** is easily controlled with the use of adjustable guides, such as the two static guides **138** depicted in Figures **2** and **3**. Thereby, the curved path **134** can be adjusted depending on the particular dimensions of the product pieces being flipped. This allows different product lines to be processed and turned over with the flipping apparatus **100**. The guides may alternatively comprise rollers, curved plates, rails, or any other apparatus for leading a conveyor belt through a circuitous path.

In a preferred embodiment **200** as depicted in **Figures 4** and **5**, the end roller **222**, which resembles a grooved roller or pulley, has a plurality of sections having alternating diameters -- larger diameter sections **242** and smaller diameter sections **244**. At a minimum, the end roller **222** has at least two larger diameter sections **242** interspersed along its length by at least one smaller diameter section **244**. A plurality of slots or channels is defined between the smaller diameter sections **244** and the larger diameter sections **242**. Each channel should be wide enough to fit at least one lane of product **212** and tall enough to allow product **212** to pass through without being crushed or jammed. In such an embodiment the end roll **222** essentially comprises a plurality of evenly spaced discs (the larger diameter sections **242**) that are interconnected along a shared axis by a plurality of smaller diameter sections **244**. A first conveyor **240**, which comprises a plurality of individual endless conveyors operating in parallel, rotates about the smaller diameter sections **244** from about a twelve o'clock position to about a six o'clock position such that each disc protrudes between adjacent belts or pairs of ropes. This first

conveyor **240** comprises a plurality of belts or ropes (or cords). The second conveyer **230** mates with and translates about the larger diameter sections **242** of the end roller **222** from about a twelve o'clock position to about a six o'clock position after the second conveyor **230** moves downstream from a curvature-segment top roller **232**. In one embodiment, a rope conveyor **240** is used as the first conveyor. The ropes from the rope conveyor **240** translate about the smaller diameter section **244** of the end roller **222**. In a preferred embodiment, each segment of the smaller diameter portion **244** comprises two grooves on either side in order to help hold a pair of ropes in place. In another embodiment, the first conveyor **240** comprises a plurality of belts rather than ropes, wherein each segment of the smaller diameter portion supports a single strip of belting. The web can comprise materials including, but not limited to, a fabric material, a metallic material, a polymer material, a chain-link material, or a wire-mesh material. Although **Figures 4** and **5** depict a particular circuitous path for the second conveyor **230** in which the second conveyor **230** makes right-angle turns around two return-path rollers **262**, the exact return path of the second conveyor **230** to and from its mating with the end roller **222** is not critical, and other variations are possible.

In operation, the first conveyor **240** carries lanes of product **212** into the channels defined between the larger and smaller diameter sections **242, 244** of the end roller **222** as the first conveyor **240** reaches and rotates about the smaller diameter sections **244** of the end roller **222**. The product **212** then transfers from the first conveyor **240** to the second conveyor **230**. Centrifugal force keeps the product **212** seated against the second conveyor **230** as it translates in a curved path **234** about the larger diameter section **242** of the end roller **222**. The product **212** is turned over as it moves along the curved path **234**. The turned-over product **212** then exits the

bottom of the channels and continues along the second conveyor **230** towards a downstream end where the second conveyor **230** translates about a downstream bottom roller **252**, which is positioned beneath the first conveyor **220**. The second conveyor **230** then begins its return path after rounding the downstream bottom roller **252**.

Figure 6 depicts another embodiment **300** in which a second conveyor **330** translates about a grooved end roller **322** having different diameter sections. Like the end roller **222** in **Figures 4** and **5**, the end roller **322** shown in **Figure 6** has at least two diameters – larger diameter sections **342** and smaller diameter sections **344**. A plurality of slots or channels is defined between the smaller diameter sections **344** and the larger diameter sections **342**. The larger diameter sections **342** substantially mate with the second conveyer **330** from about a twelve o'clock position to about a six o'clock position as both the end roller **322** and the top roller **332** rotate. Unlike the embodiment shown in **Figures 4** and **5**, however, a first conveyor **340** does not rotate about the end roller **322**. Rather than share the same rotating shaft, the first conveyor **340** instead translates about its own terminal support member **346**, which, for example, can comprise a roller or nose bar. Again, the first conveyor **340** can comprise a plurality of belts or ropes (or cords). By rotating the second conveyor **330** about a grooved roller **322** to form a curved portion for flipping, one can avoid the use of static spacers **138** as depicted in **Figures 2** and **3**, as well as benefit from the simplicity and longer durability of rollers. Furthermore, having the first conveyor **340** bypass the grooved roller **322** allows one to use a single piece of belting for the first conveyor **340** rather than a plurality of belts or ropes **240** as depicted in **Figures 4** and **5**.

By using the flipping apparatus as described herein, product pieces can be turned over

while preserving the position of the pieces relative to each other. This is beneficial considering that many shaped product pieces such as potato and corn crisps are more amenable to seasoning, stacking and packaging in one particular orientation over another. Thus, the reliable and consistent apparatus and method for flipping product disclosed herein is advantageous for achieving optimized seasoning, stacking and packaging. As the present invention dispenses with the need for vacuum rolls, conveyor permeability limitations and the associated clogging problems are avoided. The higher costs associated with operating vacuum rolls are also avoided. The present invention therefore provides a more efficient and reliable apparatus and method for flipping product with minimal product damage.

While the invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.